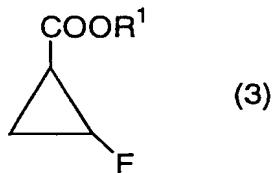


Claims

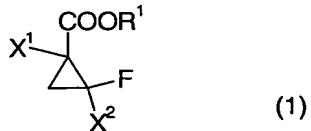
1. A process for producing a compound represented by formula (3) :

[F2]

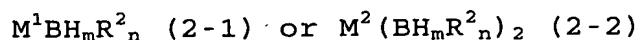


[wherein R¹ represents a C1-C8 alkyl group, a C6-C12 aryl group, a C2-C8 alkenyl group, or a C7-C26 aralkyl group], which process is characterized by comprising reacting a compound represented by formula (1) :

[F1]



[wherein X¹ represents a hydrogen atom, a chlorine atom, a bromine atom, or an iodine atom; X² represents a hydrogen atom, a chlorine atom, a bromine atom, or an iodine atom; when one of X¹ and X² is a chlorine atom, a bromine atom, or an iodine atom, the other is a hydrogen atom; i.e., X¹ and X² are not simultaneously hydrogen atoms; and R¹ has the same meaning as defined in formula (3)] with a reducing agent represented by formula (2) :



[wherein M¹ represents an alkali metal atom; M² represents an

alkaline earth metal atom or a zinc atom; R² represents a hydrogen atom, a cyano group, a C1-C8 acyloxy group, or a C1-C6 alkoxy group; m represents an integer from 1 to 4; n represents an integer from 0 to 3; and the sum of m and n is 4] in the presence of an aprotic polar solvent, and one or more Lewis acids selected from among halides and trifluoromethanesulfonic acid salts (triflates) of an atom selected from among boron, magnesium, aluminum, silicon, scandium, titanium, chromium, manganese, iron, cobalt, nickel, copper, zinc, gallium, germanium, yttrium, zirconium, silver, cadmium, indium, tin, antimony, hafnium, lead, bismuth, lanthanum, cerium, and ytterbium.

2. A production process according to claim 1, wherein X¹ is a chlorine atom, a bromine atom, or an iodine atom, and X² is a hydrogen atom.

3. A production process according to claim 1, wherein X¹ is a hydrogen atom, and X² is a chlorine atom, a bromine atom, or an iodine atom.

4. A production process according to claim 1, wherein X¹ is a hydrogen atom, and X² is a chlorine atom.

5. A production process according to claim 1, wherein X¹ is a chlorine atom, and X² is a hydrogen atom.

6. A production process according to any one of claims 1 through 5, wherein R¹ is a C1-C8 alkyl group.

7. A production process according to claim 6, wherein the C1-C8 alkyl group is a tert-butyl group.

8. A production process according to any one of claims

1 through 7, wherein the aprotic solvent is an amide solvent or a cyclic urea solvent.

9. A production process according to any one of claims 1 through 7, wherein the aprotic solvent is an amide solvent.

10. A production process according to any one of claims 1 through 7, wherein the amide solvent is one or more solvents selected from among N,N-dimethylformamide (DMF), N,N-dimethylacetamide (DMAc), and N-methyl-2-pyrrolidone.

11. A production process according to any one of claims 1 through 7, wherein the aprotic polar solvent is one or more solvents selected from among N,N-dimethylacetamide (DMAc), N-methyl-2-pyrrolidone (NMP), 1,3-dimethyl-2-imidazolidinone (DMI), and 1,3-dimethyl-3,4,5,6-tetrahydro-2(1H)-pyrimidinone (DMPU).

12. A production process according to any one of claims 1 through 7, wherein the aprotic polar solvent is N,N-dimethylacetamide (DMAc).

13. A production process according to any one of claims 1 through 12, wherein the Lewis acid is aluminum chloride, silane chloride, scandium chloride, chromium chloride, manganese chloride, iron(II or III) chloride, cobalt chloride, nickel chloride, copper(I or II) chloride, germanium chloride, zirconium chloride, silver chloride, indium chloride, tin(II) chloride, antimony(III) chloride, lead chloride, bismuth chloride, a boron trifluoride-ether complex, scandium triflate, copper triflate, silver triflate, tin triflate, or hafnium triflate.

14. A production process according to any one of claims 1 through 12, wherein the Lewis acid is aluminum chloride, iron(II) chloride, cobalt chloride, lead chloride, silver chloride, or indium chloride.

15. A production process according to any one of claims 1 through 14, wherein the reducing agent is sodium borohydride.

16. A production process according to any one of claims 1 through 15, wherein the compound represented by formula (3) has a cis configuration.